Journal of Animal Research: v.5 n.3, p. 519-526. September 2015

DOI: 10.5958/2277-940X.2015.00088.1

Effect of Detoxified Karanj Seed Cake (*Pongamia glabra* vent) Based Diets on Haematological Parameters and Body Weight Gain in Goat Kids

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Received: 13 May, 2015 **Accepted:** 06 June, 2015

ABSTRACT

A 17-weeks study was conducted to observe the effect of feeding solvent extracted karanj (*Pongamia glabra* vent) seed cake (SKC) and alkali processed solvent extracted karanj seed cake (AKC) on various haematological parameters and overall body weight gains in goat kids. Twenty non-descript male kids were randomly divided into five treatment groups viz., T_1 (control), T_2, T_3, T_4 and T_5 consisting of four kids each, under completely randomized design to make the initial body weight uniform and non-significant. The T_1 group was offered groundnut cake (GNC) as a sole source of nitrogen whereas T_2 and T_3 group were offered SKC @ 8.09% and 16.18% of concentrate mixtures respectively to replace 25% and 50% of GNC nitrogen. Similarly T_4 and T_5 were fed AKC @ 8.09% and 16.18% of concentrate mixtures respectively to replace the 25% and 50% of GNC nitrogen. No adverse effect of either SKC or AKC was observed on haemoglobin, blood glucose, blood urea nitrogen, serum total protein, serum albumin and serum globulin. The present study also revealed no significant effect of either SKC or AKC on the overall body weight gain in goat kids. These results indicates that long term supplementation of SKC or AKC up to 50% replacement of conventional nitrogen source have no adverse effect on health as revealed by body weight gain and various haematological values.

Keywords: Karanj cake, haematological parameter, body weight, kids

The limited availability and escalating cost of conventional protein feed supplement is adversely affecting the overall profitability from animal production system in India. Hence, the incorporation of cheaper and unutilized agro-industrial byproducts as protein sources need to be scrutinized to reduce the feed cost without compromising the health and welfare of animal.

Deoiled karanj cake (*Pongamia glabra* vent) is gaining importance as protein rich feed source. Deoiled karanj cake is characteristically high in CP ~30% (Ravi *et al.,* 2000) and possesses a suitable Ca: P ratio (Soren and Sastry, 2009) compared to soybean meal and cottonseed meal, supporting its evaluation as a protein supplement. Raw karanj oilseed contains anti-nutrient components such as glabrin, pongamol, tannins, and a furanoflavonoid karanjin in the oil (Vinay and Kanya, 2008) that significantly reduces the feed intake, growth, overall health and nutrient balance when animals are fed karanj seedcake meal (Singh *et al.,* 2006; Vinay and Kanya, 2008).

Singh *et al*. (2006) reported that expeller pressed karanj seedcake (EKC) was not acceptable as a feedstuff and subsequent data supports this conclusion (Nagalakshmi *et al.,* 2011). However, a closer look reveals that deoiled or solvent extracted karanj seedcake (SKC) inclusion resulted in performance comparable to control treatments. Several workers have suggested that oil free karanj seed cake (SKC) can safely be incorporated in the ration of livestock and poultry without any adverse effects on dry matter intake, body weight gain and blood biochemical parameters (Panda, 2004; Prabhu, 2002; Panda *et al.,*

2005; Dinesh *et al.*, 2013).

Gupta *et al*. (1981) reported no adverse effects on nutrient utilization when deoiled karanj seedcake made up 16% of the ration in growing calves. Similarly, Konwar *et al*. (1987) observed no difference in gain when deoiled karanj seedcake was included at a rate of 17%. In agreement, Dutta *et al*. (1993) concluded 10% inclusion of deoiled karanj seedcake into a concentrate mixture was safe for dairy cows and no unwanted effects were observed when solvent extracted karanj seedcake was included at 20% in a grain mix (Ravi *et al.*, 2000).

Panda *et al*. (2006) reported that the levels of various anti-nutritional factors like karanjin (0.132%), tannin (6.55%) and trypsin inhibitors (3.172%) in solvent extracted karanj cake that can further be eliminated by alkali treatment. The physical, chemical and microbiological processing of the solvent extracted karanj cake (SKC) can removes karanjin, the bitter principles associated with poor palatability (Soren *et al.*, 2007). Alkali treatment of SKC with 1% NaOH (w/w) could be more useful in enhancing the level of feeding of SKC in lambs (Prabhu *et al.*, 2002; Panda *et al.*, 2005) and poultry (Panda *et al.*, 2008) as it improves the palatability and digestibility of crude protein by degrading the bitter principle tannin.

Goat, being ruminant in nature, have unique adaptability to variety of feed resources and higher tolerance to various toxins and anti-nutritional factors than any other livestock units. The only study in goat also confirmed the relevance of using SKC in concentrate mixtures at 6-9% level on iso-nitrogenous and iso-calorigenous basis without any adverse effect on performance (Srivastava *et al.*, 1990). Very few reports are available concerning the effect of karanj seed cake on haematological parameter in ruminants and birds, even though these are important indicators of health and to assess the wholesomeness and suitability of any unconventional feed for animal feeding.

Konwar *et al*. (1987) observed no effect of feeding deoiled karanj seed cake in cross bred cows on haemoglobin and plasma protein at 16.6% level of incorporation. No significant differences in serum glucose and blood urea nitrogen values was found in lambs fed concentrate mixture containing SKC (20%) (Ravi *et al.*, 2001). Prabhu (2002) also observed no adverse effect of either SKC or alkali processed SKC (AKC) on blood glucose, total protein, globulin, albumin and blood urea nitrogen in lambs.

Soren (2006) observed comparable values of haemoglobin, serum glucose, albumin, globulin, albumin globulin ratio and blood urea nitrogen in lambs fed processed SKC based diets. Soren and Sastry (2009) observed no deleterious effect on microbial protein synthesis in lambs fed processed SKC. However, Reddy *et al*. (2011) found significant reduction in mean values of haemoglobin, blood glucose, total protein, albumin and globulin levels in broiler chicks when raised on raw expeller pressed karanj seed cake.

Nagalakshmi *et al*. (2012) observed no adverse effect of feeding sole karanj seed cake on haemoglobin, total protein and blood urea nitrogen in lambs. However, the albumin concentration was significantly higher and globulin concentration was decreased on karanj seed based diets.

Thus the present study was undertaken to study the long term effect of two different level of inclusion of either solvent extracted karanj seed cake (SKC) or alkali processed SKC (AKC) respectively on haematological parameter and overall body weight gain in growing goat kids.

MATERIAL AND METHODS

Twenty 3-4 months old non-descript growing male goat kids were purchased and randomly allotted to five treatment groups, T_1 (control) to T_5, of four animals each in a completely randomized design to make initial body weight uniform and non significant between treatment group. The kids were housed in a well ventilated and hygienic premise having facilities for individual feeding and watering. All the kids were vaccinated against Peste de petites, haemorrhagic septicaemia and enterotoxaemia and were dewormed with fenbendazole (5 mg/kg body weight) at regular intervals. The feeding trial was conducted for 17 weeks to observe the long term effect of karanj seed cake on haemato- biochemical values and overall health in goat kids.

One half quantity of procured solvent extracted karanj seed cake (SKC) was treated with 2.5% solution of sodium hydroxide to prepare alkali treated solvent extracted karanj seed cake (AKC). The proximate analysis was done as per standard methods of analysis (Association of Official Analytical Chemistry, 1995) (Table 1).

Table 1. Chemical composition of solvent extracated (SKC) and alkali treated (AKC) karanj seed meal (DM basis)

Chemical constituents	SKC	AKC
Proximate Principles (%)		
Moisture	7.47	5.50
Organic matter	94.10	93.80
Crude protein	32.50	32.50
Ether extract	1.23	0.50
Crude fibre	8.65	9.60
Total Ash	5.90	6.20
Nitrogen free extractives	51.72	51.20
Fibre fractions (%)		
Neutral detergent fibre	35.92	36.11
Acid detergent fibre	19.73	18.42
Acid detergent Lignin	2.90	3.05
Hemicellulose	16.19	17.69
Cellulose	8.10	7.60
Mineral Composition (%)		
Calcium	0.65	0.70
Phosphorus	0.61	0.65

Five different isonitrogenous and isocaloric concentrate mixtures were prepared (Table 2) using groundnut cake alone or in combination with SKC or AKC in such a way to meet the crude protein requirement of individual kid to the extent of 80% level of NRC (1985) specified values. The control group (T_1) was fed groundnut cake as sole source of nitrogen while T_2 and T_3 groups and T_4 and T_5 groups fed with same type of feed with variable quantities of either SKC (T_2 and T_3) or AKC (T_4 and T_5) along with groundnut cake. 25% nitrogen of groundnut cake was replaced by SKC and AKC in T_2 and T_4 groups, respectively. Similarly 50% nitrogen of groundnut cake was replaced by SKC and AKC in T_3 and T_5 groups, respectively.

The kids were offered daily weighed quantities of the respective concentrate mixtures in morning to meet their protein requirements (NRC, 1985) for maintenance and growth. Dry matter requirements were met through *ad libitum* supply of finger millet (Ragi straw). The quantity of concentrate mixture to be offered daily was adjusted

Table 2. Ingredient composition of different concentrate mixtures

Ingredient	Concentrate Mixtures (kg/ton)				
	T_1 Control	T_2 25% SKC	T_3 50% SKC	T_4 25% AKC	T_5 50% AKC
Maize	220.00	23.00	23.00	230.00	230.00
Ragi	90.00	51.60	15.00	51.60	15.00
Jower	117.00	107.00	100.20	107.00	100.20
Rice polish	290.00	310.00	335.00	310.00	335.00
GNC	250.00	187.50	125.00	187.50	125.00
SKC	-	80.90	161.80	-	-
AKC	-	-	-	80.90	161.80
Mineral mix	23.00	23.00	23.00	23.00	23.00
Salt	10.00	10.00	10.00	10.00	10.00
Vitamins	1.00	1.00	1.00	1.00	1.00
Total	1000.00	1000.00	1000.00	1000.00	1000.00
Calculated Nutrient Levels					
TDN%	71.94	71.20	70.35	71.20	70.35
CP%	18.03	17.97	17.94	17.97	17.94
Ca%	1.50	1.55	1.60	1.58	1.67
P%	0.65	0.83	0.64	0.93	0.86

weekly as per body weight recorded at the end of every week. Fresh drinking water was provided *ad libitum* twice daily.

The blood samples were collected aseptically from jugular vein of each animal at the starting of experiment, at 58th day of trial and at the end of the experiment for the estimation of haemoglobin, blood glucose, blood urea nitrogen, total plasma protein, plasma albumin and plasma globulin.

All the kids under study were weighed individually in the morning before feeding and watering using an electronic weighing scale to assess the change in body weight in order to observe the effect of different treatments on the body weight gain and overall health of animals.

Haemoglobin was assayed by Sahli's acid-hematin method (Benjamin, 1985). Blood glucose was determined by GOD (glucose oxidase)/POD (peroxidase) method (Trinder, 1969). Blood urea nitrogen was estimated by diacetyl monoxime method (DAM) method (Wybenga *et al.*, 1971). Total plasma protein and albumin were determined as per Doumas (1975) and Doumas *et al.* (1971). Serum globulin was obtained by subtracting of albumin from total serum protein.

Table 3. Mean blood glucose, hemoglobin and blood urea nitrogen (BUN) of goat kids

Tr. No.	Mean Serum glucose (mg/dl) NS			Mean Blood hemoglobin (g%) NS			Mean Blood urea nitrogen (mg/dl) NS		
	1st Day	58th Day	119th Day	1st Day	58th Day	119th Day	1st Day	58th Day	119th Day
T_1 -control	29.77 ± 3.07	16.97 ± 3.01	36.12 ± 2.79	10.40 ± 0.40	10.18 ± 0.81	10.40 ± 0.53	16.64 ± 0.51	18.39 ± 1.11	17.98 ± 0.76
T_2 -25% SKC	40.71 ± 1.09	10.45 ± 1.49	31.44 ± 2.16	9.85 ± 0.36	11.65 ± 1.27	11.53 ± 0.65	18.44 ± 0.71	20.01 ± 0.73	20.06 ± 0.97
T_3 -50% SKC	53.37 ± 13.80	11.21 ± 1.99	35.95 ± 2.02	10.88 ± 0.70	10.60 ± 0.74	10.83 ± 0.37	18.52 ± 0.78	21.32 ± 0.99	20.16 ± 0.95
T_4 -25% AKC	26.40 ± 3.29	17.64 ± 6.95	31.44 ± 6.02	11.25 ± 0.64	12.35 ± 1.22	11.83 ± 0.94	17.72 ± 1.48	19.46 ± 1.07	18.59 ± 1.05
T_5 -50% AKC	27.39 ± 2.62	13.46 ± 1.16	35.87 ± 7.58	11.30 ± 0.91	9.60 ± 0.86	10.63 ± 0.52	17.59 ± 0.95	20.52 ± 0.93	19.26 ± 0.94

NS = Non-significant

The experimental data was subjected to statistical analysis using analysis of variance technique as described by Snedecor and Cochran (1989) and accordingly the results were interpreted.

RESULTS AND DISCUSSION

The mean haemoglobin values were found to be non-significant among the different treatments (Table 3) on feeding concentrate mixtures containing SKC or AKC during the whole trial as reported in calves (Konwar *et al.*, 1987) and lambs (Prabhu, 2002; Soren *et al.*, 2010). The values observed at the end of the trial were quite similar to the initial values which suggest no variable effect of SKC and AKC on blood haemoglobin.

A similar serum glucose level among the various treatment groups (Table 3) following the feeding of SKC and AKC was recorded. The mean serum glucose concentrations in the beginning, midway and at the end of experimental period ranged from 26.40 (T_4) to 53.37 (T_3), from 10.45 (T_2) to 17.64 (T_4) and from 31.44 (T_2 and T_4) to 36.12(T_1) mg/dl, respectively (Table 2). The observed non-significant effect of SKC and processed SKC (AKC) on serum glucose in goat kids was in agreement with the findings of Ravi *et* al. (2001), Prabhu (2002) and Soren *et al*. (2010) in lambs. The downward trend observed in glucose values during midway of experiment may be due to adaptation period required for the long term feeding of karanj seed cake.

The blood urea nitrogen (BUN) concentration indicates the level of breakdown of protein and amino acids in the rumen and the rate of utilization of ammonia for microbial protein synthesis. An increase in BUN level may reflect an accelerated rate of protein catabolism (Kaneko, 1980) and renal tubular necrosis (Kaysen *et al.*, 1985) whereas the reduced level indicates severe hepatic insufficiency and diminished protein intake.

The observed non-significant value of mean blood urea nitrogen (BUN) between different treatments (Table 3) in the present study agrees with the finding of Ravi *et al*. (2001) in lambs, suggesting the possibility of inclusion of SKC or AKC in the feeding regime of goats without any adverse effect. The mean blood urea nitrogen values at the beginning, midway and at the end of the trial ranged from 16.64 (T_1) to 18.52 (T_3), from 18.39 (T_1) to 21.32 (T_3) and from 17.98 (T_1) to 20.16 (T_3) mg%, respectively.

It was observed that there were no significant ($p \geq 0.05$) differences in serum total protein levels (Table 4) of the kids fed different diets either initially or at any given interval. The protein values observed in the present study are in agreement with the normal serum protein value in goats (James, 1978). However Soren *et al*. (2010) observed significantly lower serum total protein in lambs fed lime

Table 4. Mean blood total protein, albumin and globulin of different groups of goat kids

Tr. No.	Mean Serum Total Protein NS			Mean Serum Albumin NS			Mean Serum Globulin NS		
	1st Day	58th Day	119th Day	1st Day	58th Day	119th Day	1st Day	58th Day	119th Day
T_1 – C	6.89 ± 0.68	7.31 ± 0.35	7.91 ± 0.31	3.04 ± 0.09	3.51 ± 0.11	3.24 ± 0.18	3.85 ± 0.76	3.79 ± 0.26	4.67 ± 0.14
T_2 -25% SKC	6.41 ± 0.42	7.28 ± 0.23	7.87 ± 0.30	3.02 ± 0.23	3.43 ± 0.05	3.45 ± 0.09	3.39 ± 0.40	3.85 ± 0.26	4.42 ± 0.27
T_3 -50% SKC	8.42 ± 1.97	8.00 ± 0.51	7.90 ± 0.21	3.13 ± 0.12	3.23 ± 0.16	3.31 ± 0.05	5.29 ± 2.07	4.77 ± 0.64	4.59 ± 0.18
T_4 -25% AKC	7.16 ± 0.74	7.53 ± 0.36	7.85 ± 0.098	3.12 ± 0.18	3.23 ± 0.06	3.40 ± 0.05	4.03 ± 0.65	4.29 ± 0.38	4.45 ± 0.14
T_5 -50% AKC	9.86 ± 1.32	8.73 ± 0.81	7.57 ± 0.13	3.09 ± 0.19	3.24 ± 0.16	3.15 ± 0.11	6.77 ± 1.32	5.49 ± 0.90	4.42 ± 0.16

NS = Non-significant

treated SKC. A 75% substitution of GNC-N with that of SKC in growing calves rations had led to a significant ($p \leq 0.05$) increase in concentration of plasma protein (Konwar *et al.*, 1987). Such trend was not evident in the present study possibly because of low level of SKC as well as due to species difference. The serum protein level indicates the balance between anabolism and catabolism of protein in the body and gets altered during liver and kidney malfunctioning.

Albumin supplies readily available pool of amino acids to meet the tissue needs depending on nutritional status as its synthesis is diminished during fasting or malnutrition, hormonal imbalance and a generally poor condition of liver. The mean serum albumin values in the beginning, midway and at the end of experimental period (Table 4) were not clinically significant and ranged from 3.02 (T_2) to 3.13 (T3), from 3.23 (T_3 and T_4) to 3.51 (T_1) and from 3.15 (T_5) to 3.45 (T_2) g/dl, respectively. However the values were found to be in the normal range, i.e., 2.7-3.9 g/dl, as reported by Coles (1986) in goats.

The mean serum globulin values were also found to be non-significant ($p \geq 0.05$) during different intervals (Table 4). The serum globulin values at the beginning, midway and at the end of the trial were ranged from 3.39 (T_2) to 6.77 (T_5), from 3.79 (T_1) to 5.49 (T_5) and from 4.42 (T_2 and T_5) to 4.67 (T_1) g/dl, respectively. It was observed that mean serum globulin values increased subsequently at every collection for 25% level of replacement of GNG-N with SKC and AKC-N, respectively, while a downward trend was observed at 50% level of replacement. Coles (1986) reported average globulin values ranging from 2.7-4.1 g/dl in goats. Nagalakshmi *et al*. (2012) also observed significantly higher values of serum albumin and lower values of globulin in lambs fed sole karanj seed cake based diets.

The comparable serum total protein, albumin and globulin levels observed among kids on different feeding regimen in the present study clearly indicates normal balance between anabolism and catabolism of body protein. The observed non significant differences in concentration of serum albumin, globulin and blood urea among different treatment groups in goat kids agrees with the findings of Prabhu (2002) and Soren *et al*. (2010) in lambs raised on karanj seed cake containing concentrate mixtures.

Body growth is greatly influenced by factors like plane and type of nutrition. Body weight gain is one of important indicator to assess the health status of animal and reflects the overall suitability and integration of any unconventional feed in the feeding regime.

The group wise weekly body weight gain of kids during the trial has been presented in Table 5. During most of the week, the average daily body weight gain was non-significantly different between various treatment groups. The occasional occurrence of significant ($p \leq 0.05$) treatment differences in 5th and 12th wk however appear to have been due to environmental variation rather than the diet per se. The non-consistent nature of change in magnitude of body weight of goat kids during any specific weeks was attributed to the ruminating nature of kids and was not found to be related with levels of SKC and AKC in the diets. Not-withstanding such variable trends in the body weight during individual weeks, the average final body weight at the end of the trial among the five dietary

Table 5. Average daily body weight gains of goat kids in different treatments during different weeks of growth trial

		Body weight gain (g/head/day)				
		T_1 Control	T_2 25% SKC	T_3 50% SKC	T_4 25% AKC	T_5 50% AKC
Av. Initial Wt. (kg)^{NS}		10.32 ± 1.08	11.56 ± 0.61	10.68 ± 0.66	10.66 ± 0.61	10.53 ± 0.44
WEEKS	1^{NS}	80.00 ± 15.07	150.00 ± 20.75	85.70 ± 32.68	58.57 ± 39.48	52.86 ± 47.24
	2^{NS}	27.86 ± 5.87	27.86 ± 25.59	-28.50 ± 38.10	-10.00 ± 19.01	0.00 ± 21.35
	3^{NS}	-15.71 ± 22.02	-4.28 ± 23.34	13.50 ± 27.54	10.00 ± 33.90	-48.57 ± 46.20
	4^{NS}	93.57 ± 26.14	12.86 ± 27.91	81.40 ± 24.29	7.85 ± 24.95	60.00 ± 28.74
	5*	62.86 ± 15.16^{ab}	74.29 ± 29.90^{a}	23.57 ± 26.86^{b}	26.43 ± 21.42^{ab}	24.29 ± 8.29^{ab}
	6^{NS}	-26.43 ± 28.79	-60.71 ± 21.52	7.14 ± 44.30	-15.00 ± 19.07	-9.28 ± 10.52
	7^{NS}	5.00 ± .39	-27.86 ± 29.33	-58.50 ± 70.38	60.71 ± 25.19	-14.29 ± 20.70
	8^{NS}	-12.14 ± 25.24	-7.85 ± 48.41	-5.75 ± 22.92	-0.714 ± 19.04	19.29 ± 23.66
	9^{NS}	51.43 ± 18.99	51.43 ± 19.59	42.14 ± 24.45	-4.28 ± 9.36	0.00 ± 12.51
	10^{NS}	52.86 ± 11.75	14.29 ± 15.25	20.00 ± 24.10	-14.29 ± 32.22	7.14 ± 12.91
	11^{NS}	24.29 ± 22.21	29.29 ± 25.27	32.14 ± 10.78	62.86 ± 25.90	32.86 ± 22.02
	12*	58.57 ± 18.16^{a}	15.00 ± 25.59^{ab}	-16.43 ± 19.43^{ab}	-40.71 ± 14.16^{b}	-20.00 ± 7.37^{ab}
	13^{NS}	22.14 ± 18.46	-16.43 ± 26.66	-4.28 ± 10.72	25.71 ± 18.99	-7.14 ± 11.69
	14^{NS}	-36.43 ± 14.86	-13.57 ± 24.14	-20.71 ± 17.51	-16.43 ± 22.72	-27.14 ± 13.83
	15^{NS}	87.86 ± 20.62	53.57 ± 15.53	55.71 ± 11.34	65.71 ± 16.62	55.00 ± 15.67
	16^{NS}	3.92 ± 11.30	17.14 ± 20.90	-58.57 ± 46.22	5.71 ± 10.10	-51.43 ± 40.22
	17^{NS}	52.50 ± 14.93	41.43 ± 11.69	45.00 ± 15.97	52.14 ± 22.05	76.43 ± 23.37
Cumulative^{NS} gains		31.30 ± 9.79	20.97 ± 11.39	9.79 ± 10.49	16.13 ± 8.07	8.82 ± 9.10
Av. Final Wt. (kg)^{NS}		14.04 ± 0.7486	14.05 ± 1.032	11.85 ± 1.067	12.58 ± 0.7862	11.58 ± 0.6852

NS Non-significant

* With in a row, means bearing at least one common superscript are statistically (P≤0.05) similar.

groups on the contrary turned out to be non-significantly (p≥0.05) different from each other (Gupta *et al.*, 1981; Srivastava *et al.*, 1990; Prabhu 2002; Soren *et al.*, 2009). The relatively moderate gains observed at 25% level of replacement of groundnut nitrogen do suggest that goat can tolerate the karanj seed cake to a substantial extent renewing its usage for stall-fed goats (Prabhu, 2002).

Thus the present study reveals that long term feeding of SKC and AKC as replacement of groundnut cake may not affect body weight (Dinesh *et al.*, 2013) and do not affect the overall health of the goat kids in terms of non-significant changes in various blood biochemical parameter (Ravi *et al.*, 2001; *Nagalakshmi et al.*, 2012) contrary to the changes observed by Reddy *et al.* (2011) in chicks fed

raw expeller pressed karanj seed cake (EKC). Hence blood biochemical parameters may aid in performance study and provide a better picture on overall effect on health about inclusion of karanj seed cake in the diet of goats.

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